



Attempt questions first; check the separate key afterward. Use $g=10 \text{ m/s}^2$. Treat machines as ideal only when explicitly stated.

A. Very short answers - 1 mark each

1. State the SI unit of work.
2. A 10 N force moves an object 5 m along its direction. Find work.
3. Is work by a force zero when displacement is perpendicular to it?
4. Explain work done by the force supporting a bag carried horizontally at constant height.
5. Find kinetic energy of 2 kg moving at 4 m/s.
6. If speed doubles, find the new kinetic energy.
7. Find gravitational potential energy gained by 3 kg lifted 5 m; $g=10 \text{ m/s}^2$.
8. Find work against gravity for the lift.

B. Short answers / practice - 2 marks each

9. A machine does 600 J work in 12 s. Find power.
10. A 100 W machine works for 30 s. Find energy transferred.
11. Define mechanical advantage.
12. A machine lifts 300 N using 75 N effort. Find mechanical advantage.
13. A machine has velocity ratio 5 and mechanical advantage 4. Find efficiency.
14. Can an ordinary real machine have efficiency above 100%?
15. Name the three parts of a lever.
16. Classify seesaw, wheelbarrow and tweezers by lever class.
17. A lever has effort arm 60 cm and load arm 20 cm. Find ideal mechanical advantage.
18. Find effort needed for a 90 N load ideally.
19. What is the ideal mechanical advantage of a single fixed pulley?
20. Explain why it is still useful.

C. Application / reasoning - 3 marks each

21. An ideal single movable pulley supports 100 N. Find effort.

22. How far must effort move to raise the load 20 cm?

23. A ramp is 5 m long and 1 m high. Find ideal velocity ratio.

24. Find ideal effort to move a 500 N load up it.

25. Input energy is 800 J and useful output is 600 J. Find efficiency.

26. Account for the remaining energy.

27. A 5 kg load is lifted 2 m in 4 s; $g=10 \text{ m/s}^2$. Find work and useful power.

28. A machine's load is 600 N and effort is 150 N. Find mechanical advantage.

29. A machine with velocity ratio 8 has efficiency 75%. Find mechanical advantage.

30. Explain why an inclined plane reduces effort but increases effort distance in the ideal case.

31. A body's mass doubles at unchanged speed. What happens to kinetic energy?

D. Extended practice - 5 marks per pair

32. A 2 kg ball falls from 5 m. Ignoring air resistance, find kinetic energy just before ground.
33. Find its speed; $g=10 \text{ m/s}^2$.
34. Does a simple machine reduce the ideal total work required?
35. Compare lever, pulley and inclined plane using diagrams, mechanical advantage and energy conservation.

ANSWER KEY - Numerical / closed questions

- 1) Joule. 2) 50 J. 3) Yes. 4) Zero by vertical supporting force. 5) 16 J. 6) 64 J. 7) 150 J. 8) 150 J. 9) 50 W. 10) 3000 J. 11) Load/effort. 12) 4. 13) 80%. 14) No. 15) Fulcrum, effort, load. 16) I, II, III. 17) 3. 18) 30 N. 19) 1. 20) Changes direction of effort. 21) 50 N. 22) 40 cm. 23) 5. 24) 100 N. 25) 75%. 26) 200 J dissipated, mainly as thermal energy/sound. 27) 100 J; 25 W. 28) 4. 29) 6. 30) It doubles. 31) 100 J. 32) 10 m/s. 33) 10 m/s. 34) No.